
WATER, WATER EVERYWHERE

“Water, water everywhere / Nor any drop to drink.”

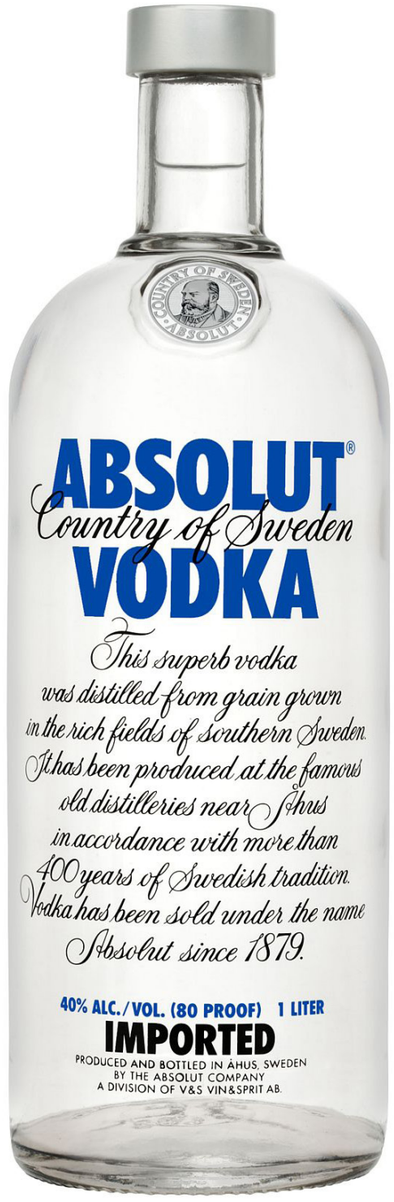
-Samuel Taylor Coleridge

Imagine a world with no more fresh water.
You have to carry around the water which
you will use for the rest of your life -
heating it with your body temperature,
treating it with portable filters,
reusing and recycling it over and over again.

* * *

Of course, such a view is radical, and a seemingly far cry from today's reality, but it is not altogether implausible, especially the way we are going.

Freshwater constitutes only 3% of the total water on earth, of which only 1% is available for use, most of it in the form of groundwater.

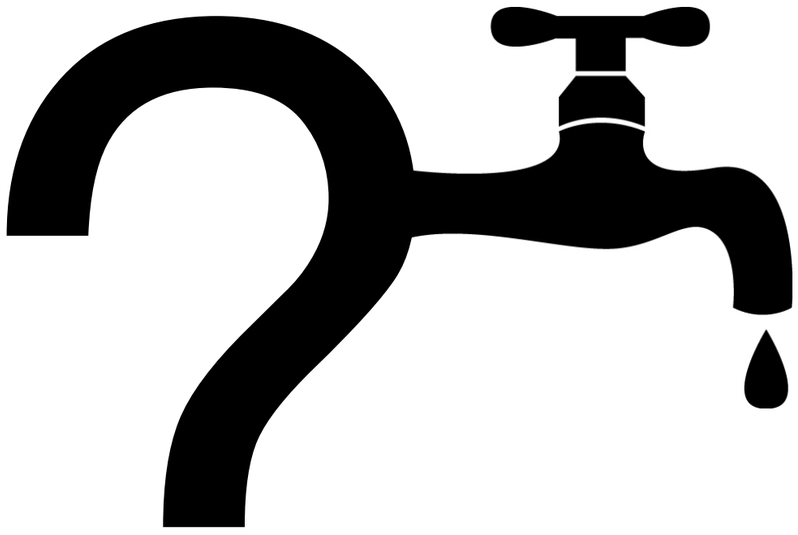


all water

fresh water

The problem is not so much accessing this water,
but creating and maintaining the infrastructures
to treat, store, and transport this water.

An even bigger program of the last century has been
the increased pollution of our water sources by
agriculture chemicals, heavy metals from industry,
detergents and cosmetic products,
hormones and endocrine disruptors,
microbial contaminants and other pathogens.



The shift from country to city has resulted in the centralization of our water systems. As with food and energy, this has removed the average user from the water cycle, causing dependency on an unknown system.

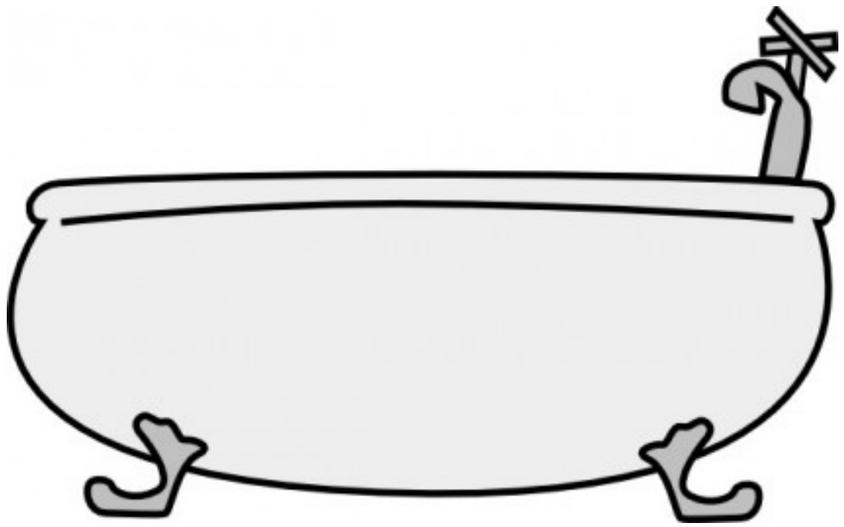
Without realizing it, we are putting great strain on a valuable resource, the effects of which are being felt even in Barcelona.

Wednesday 14 May 2008 08.40 BST

theguardian
Winner of the Pulitzer prize

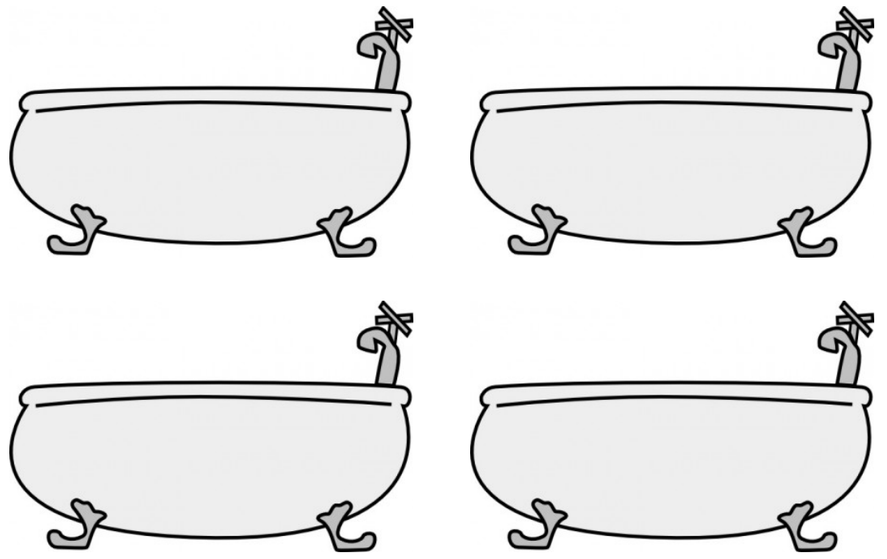
Barcelona forced to import emergency water

- Southern regions say move politically biased
- Catalonia's reservoirs three-quarters empty



Our problem is not just that we take water for granted, but that we are blissfully unaware of our water usage patterns.

When asked how much water IaaC students *think* they use on a daily basis, most of them answered 100 L or less.

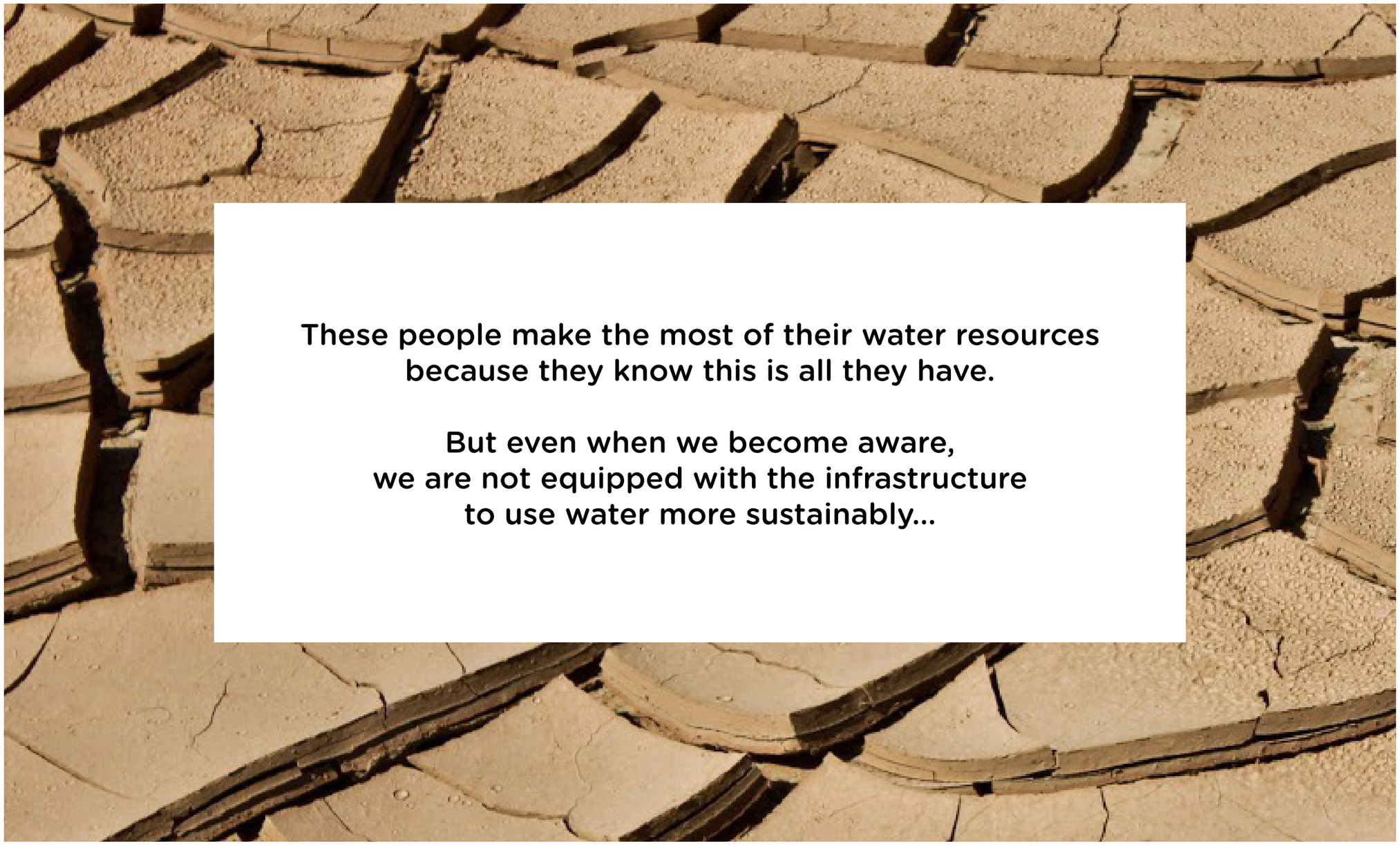


The average person actually uses close to **200 L** (and up to 400 L) of water per day.

These numbers fail to include *embedded water* - the water which we need to grow our food, fabricate our clothes, and manufacture our products.

In Africa, women must walk for hours each day
in order to collect water for their communities.

In space, every drop of water must be reused
for months (yes, that includes urine).



These people make the most of their water resources
because they know this is all they have.

But even when we become aware,
we are not equipped with the infrastructure
to use water more sustainably...

Valldaura gets its water trucked in from the city:

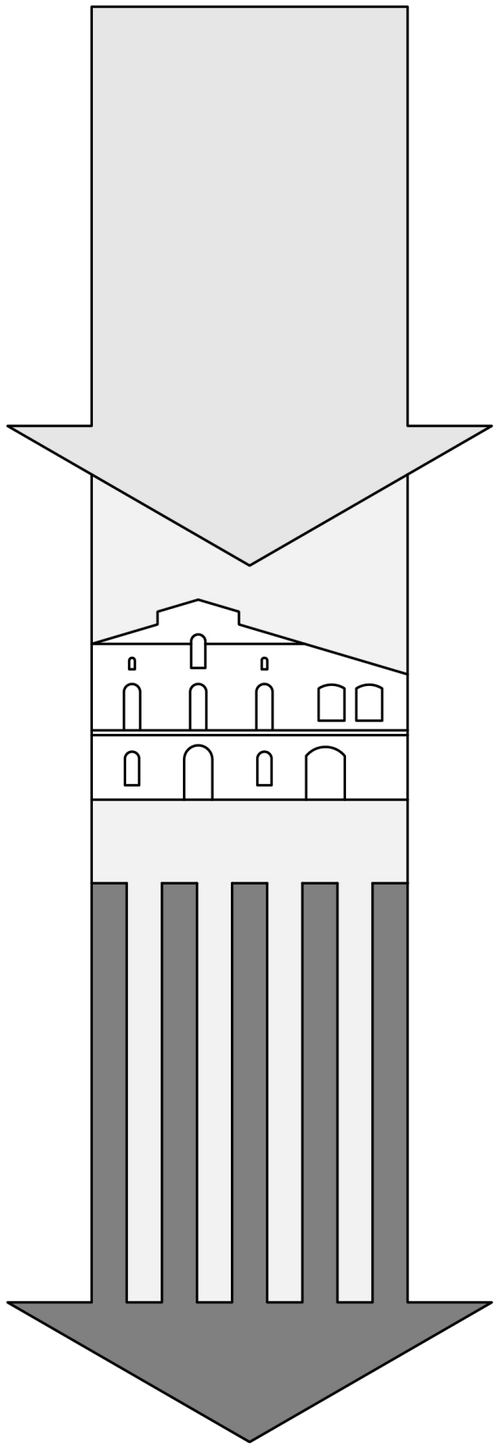
10,000 L per delivery,
x ~20 deliveries per year
= ~ 200,000 L per year

Valldaura collects annually around 600 L of rainwater from the house and terraces, and between 10,000 and 20,000 L of rainwater from the forest.

At a conservative estimate, this provides roughly 30 L of water daily for all inhabitants and guests.

Valldaura has the potential to collect between 25,000 and 30,000 L of rainwater per year, which would allow for about 80 L of water on a daily basis.

When it comes to waste management, a commonly used motto is “Reduce, Reuse, Recycle”. It can also be applied to water conservation.



Reducing provides the biggest savings by causing awareness and easily implementable behavioural and lifestyle changes.

Over the course of this semester, as a result of my increased water awareness, I managed to reduce my daily water use from 160 to 80 L, which is the best case daily water collection scenario for Valldaura.

However, with three permanent and four temporary residents who are currently staying at Valldaura, as well as occasional guests and regular events, this is not enough water to sustain everyone and their activities.

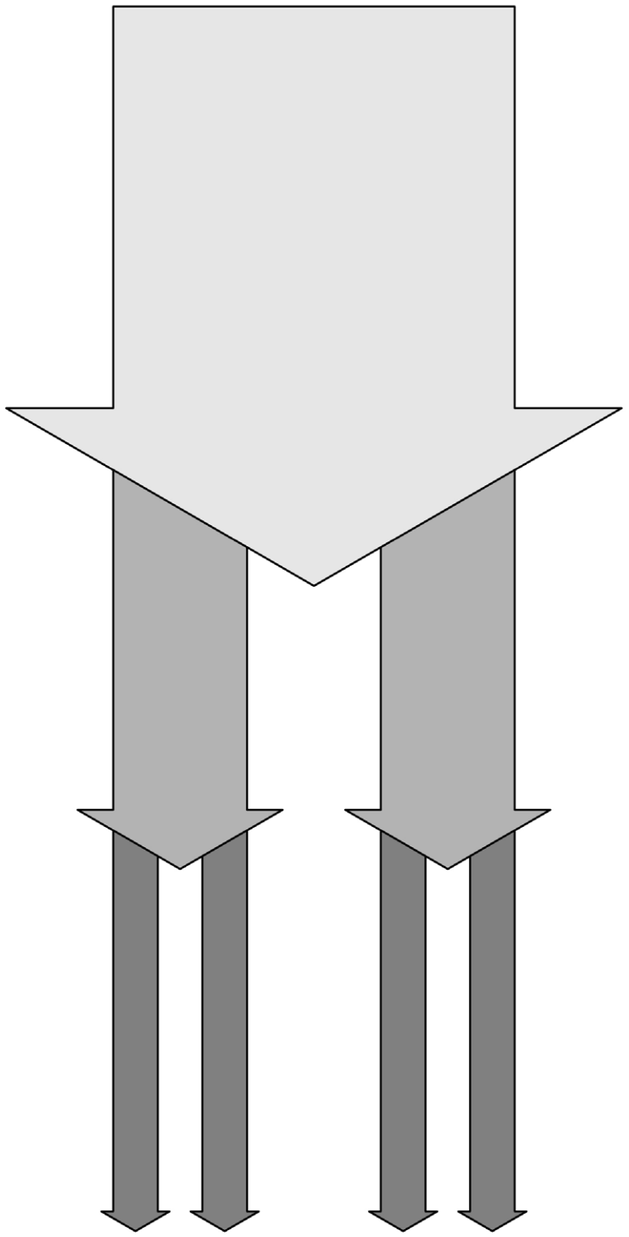
In addition, reducing water use does not resolve the *linear nature* of the system.

The tricky part with regards to water reduction involves behaviour modification. Our current water distribution system does not provide any kind of feedback for its users with regards to how much water they are using or how much water they should use. Without feedback signals or visible cues, it is difficult to gauge, adjust, or limit one's water use.

One possible solution could be to install displays at each water source that provide live feedback about how many litres you are consuming. However, for most people, numbers alone would be meaningless without an understanding of the global context.

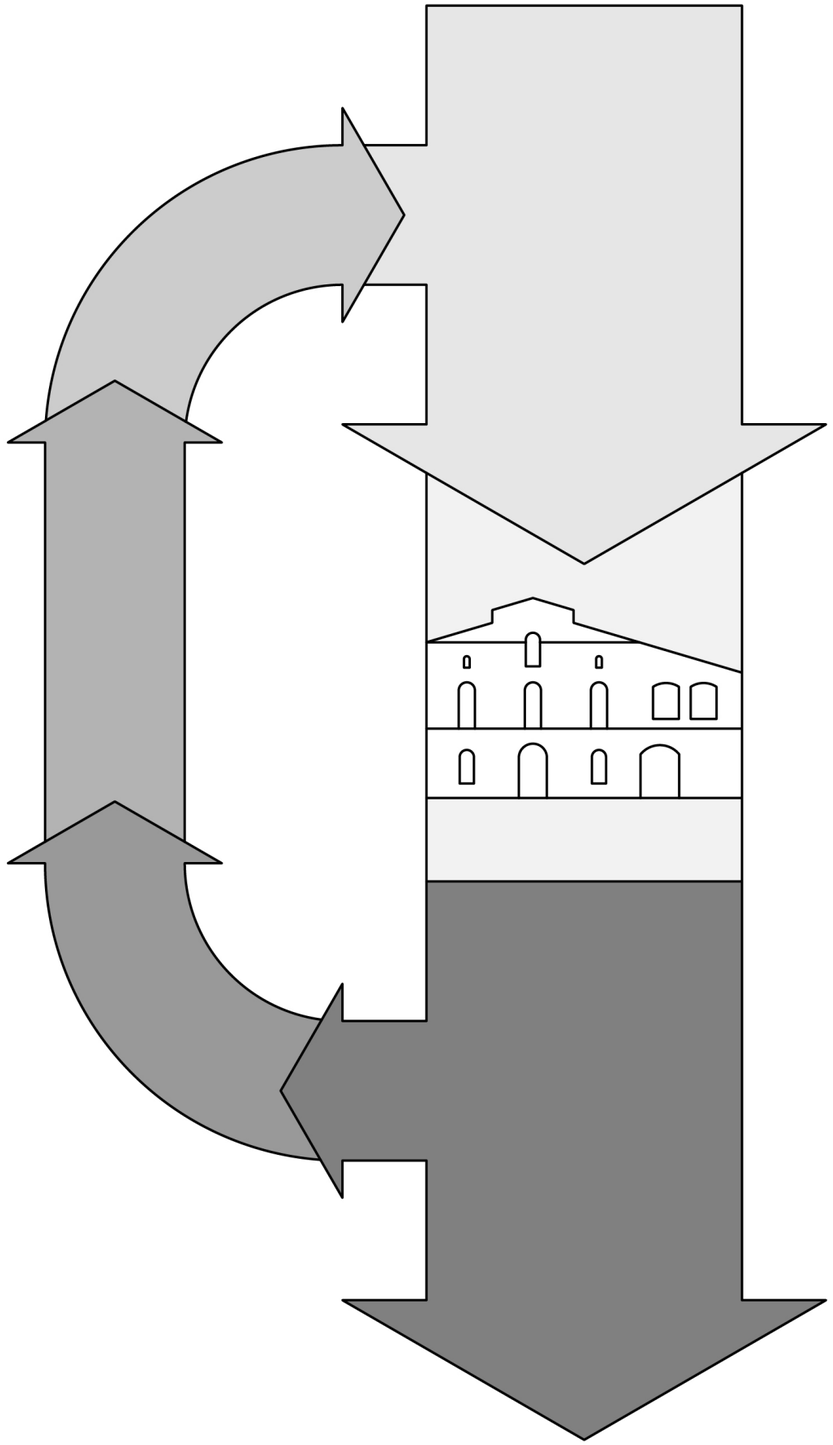
Another possibility might involve more haptic feedback, such as the *eco warrior shower curtain*, or a more humanistic approach, like the *poor little fishbowl sink*, both pictured on the right.

Unfortunately, without extrinsic pressures or intrinsic motivation, these approaches would not be effective. And since different people have different water needs, it would be difficult to determine how much water someone should use (assuming there is no water shortage situation).



A quick guide to reducing domestic water:

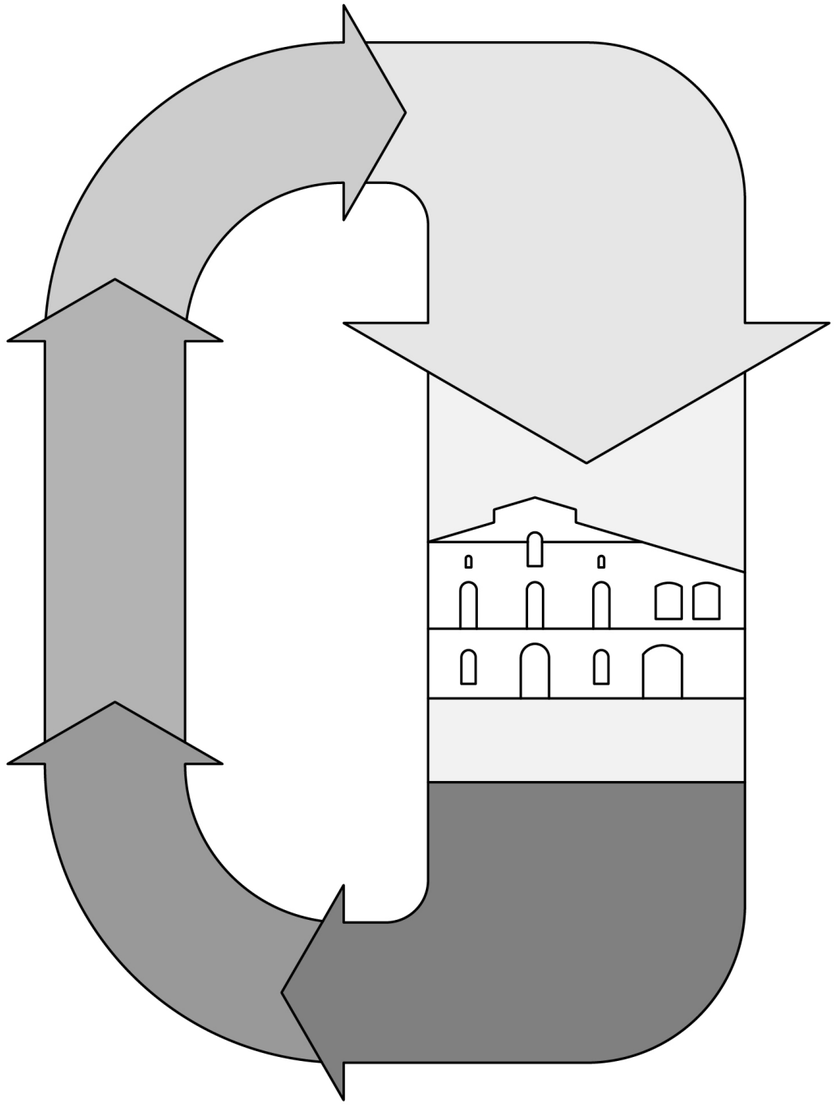
> turn off water when not using it!
> fix leaks and drips right away
> don't turn on the tap all the way (slow the flow)
> install aerators or low-flow faucets
> don't run water while brushing teeth
> don't run water until it is cold (for drinking)
> don't run water until it is hot (for washing)
> handwash dishes in a basin
> turn off shower water while soaping
> take shorter showers
> take showers less frequently
> use the toilet multiple times before flushing
> don't use toilet as wastebasket
> use a toilet water displacement bag
> install low flow or dual flush toilets
> install a urine diverter
> install a dry or compost toilet
> install a modern HE washing machine
> install a modern HE dishwasher
> only wash full loads for dishes and laundry
> water plants at night to avoid evaporation



Water *reuse* and *recycling* both have a lot of unconsidered potential.

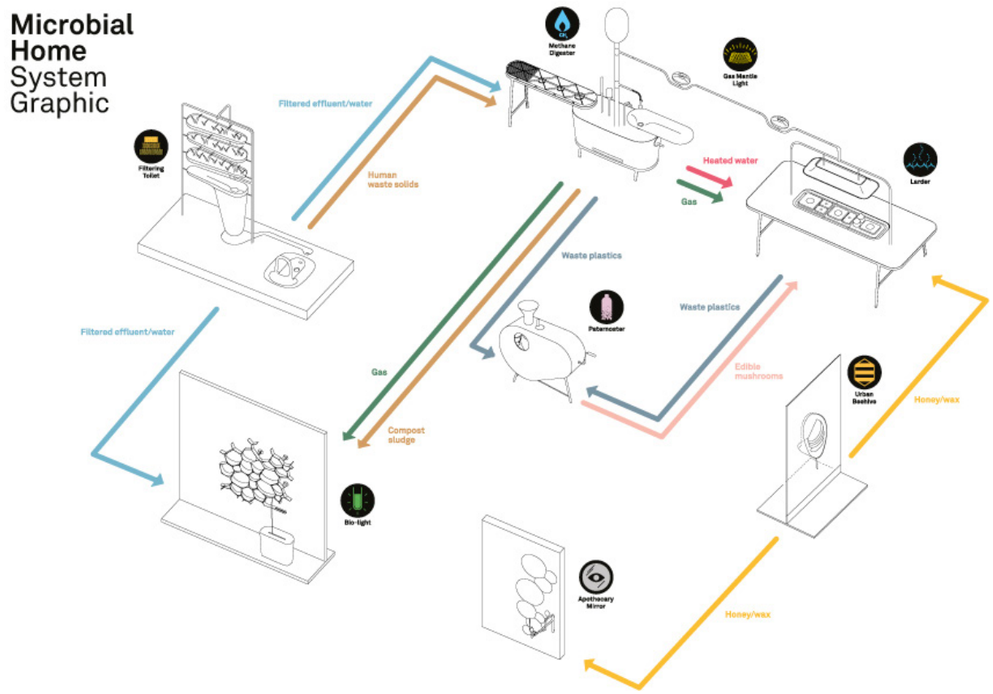
Just like with solid wastes, not all wastewater is created equal. The wastewater from washing produce is relatively pristine and uncontaminated compared to the wastewater from flushing the toilet. And yet the current system treats all wastewater equally.

By classifying and discriminating between different wastewater types, we can remap the current system to allow different wastewaters to be reused for different purposes along the cycle.



Water *recycling* takes water reuse a step further by involving a series of water treatment and purification systems in order to upcycle the water to a more usable (or even potable) state.

This project, the *microbial home design probe*, was an inspiration from the beginning. Although it does not use water, it demonstrates how a remapping of existing functions can result in a metabolic, closed-loop system that makes the most of every resource in the cycle.



In order to reuse and recycle water effectively, it is important to classify the different types of wastewater and understand their potential uses and effects within the system.

Generally speaking, wastewater can be classified into *greywater* and *blackwater*.

Greywater is the relatively clean wastewater from baths and showers, sinks, and washing machines. It contains mostly soaps and detergents and has relatively little contamination.

Blackwater, or sewage, is any wastewater that contains fecal matter and urine. It contains pathogens that are dangerous to human health, therefore treating blackwater involves a much more intensive process than greywater.

Greywater can be further subdivided into:
> clear water (from running the tap)
> practically clear water (from washing produce)
> diluted greywater with low concentrations of contaminants (e.g. shower and bath water)
> greywater with higher concentrations of contaminants (e.g. washing machines)

Contaminants can include:
> organic substances (e.g. hair, food, skin)
> oils and grease (also organic)
> soaps and detergents
> inorganic substances (minerals, salts, metals)
> toxins (artificial chemicals, cleaning products)

It is particularly important to think about the contaminants when considering how your greywater will eventually be reused. For example, while diluted concentrations of biodegradable soaps and detergents are relatively harmless, powerful cleaning products and other toxins might seriously harm plants if they are irrigated with greywater that contain such contaminants.

To recycle greywater, multiple purification options are available. Importantly, the more contaminants there are in the greywater, and the more complex the contaminants, the more sophisticated the purification system must be in order to filter them. Another consideration is that filters must also be cleaned or replaced, so certain water treatment systems are not ideal for domestic purposes.

To filter:
> paper/cloth filter
> sand filter (pictured on left)
> ceramic filter

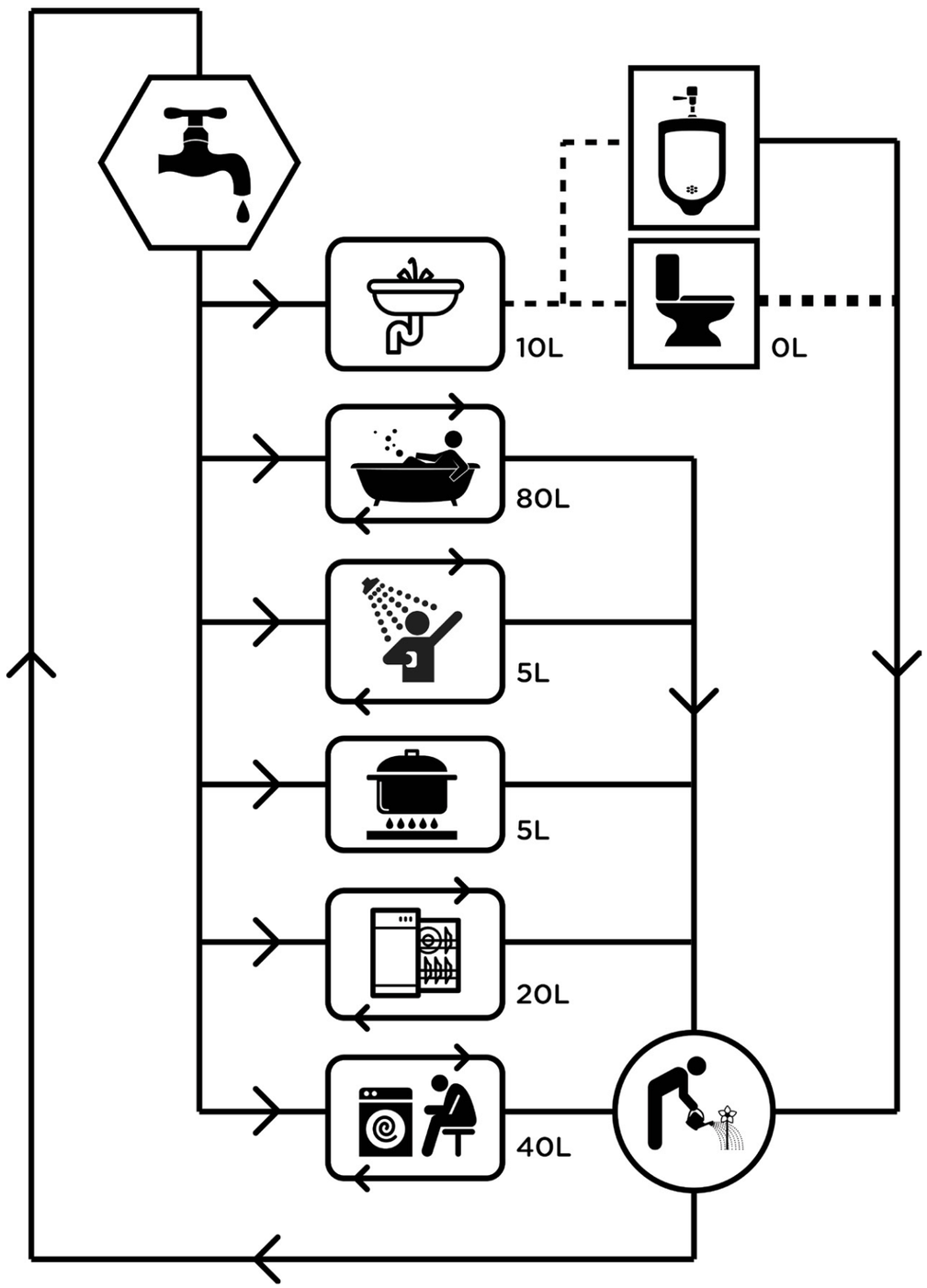
To disinfect:
> boiling
> solar disinfection
> UV disinfection
> ozone disinfection
> chemical disinfection (chlorine, iodine)

To filter and disinfect:
> activated carbon filter (pictured on left)
> biofilters (aka constructed wetlands)
> solar distillation

Image 1:
1. *potable water*
2. *greywater from washing dishes*
3. *passed through paper filter to remove solids*
4. *passed through sand filter*

Image 2:
1. *potable water*
2. *kitchen water passed through paper filter*
3. *bathroom water with no filtration*

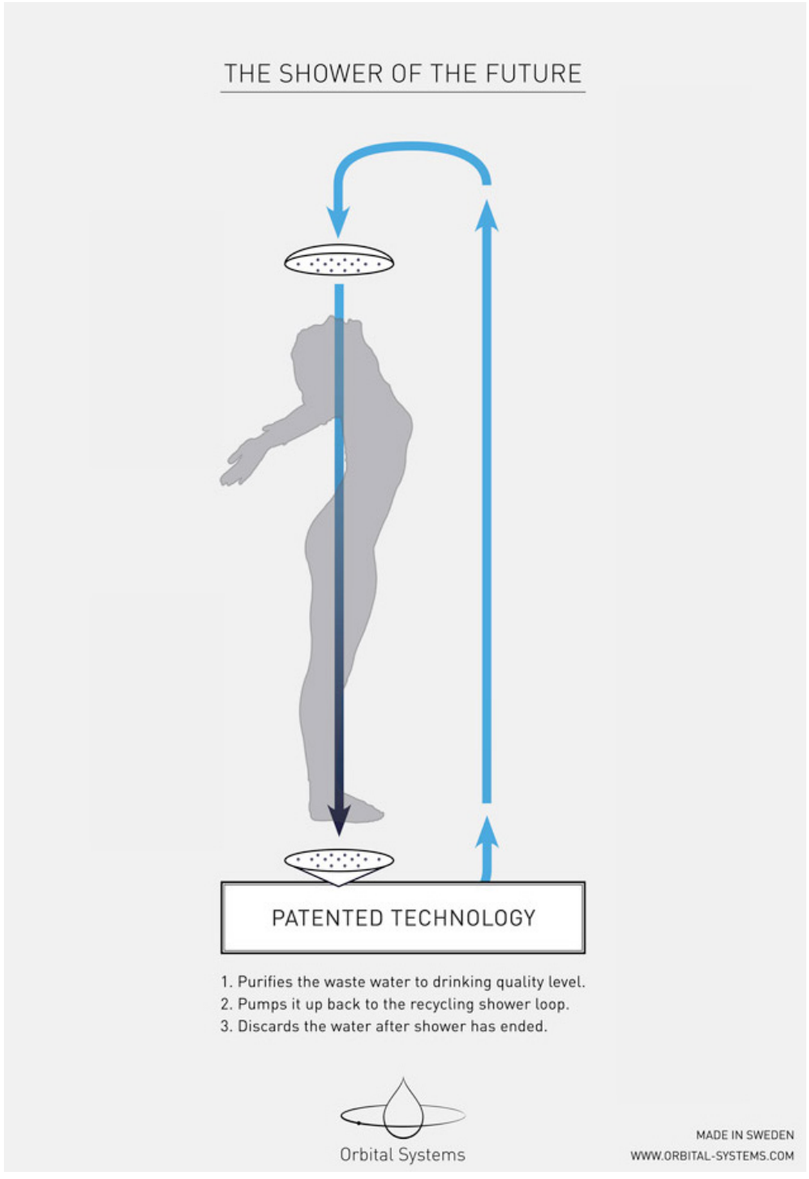
Image 3:
1. *potable water*
2. *cooking water with oil*
3. *cooking water passed through paper filter*



My remapping proposal assumes an ideal scenario which involves retrofitting certain components of Valldaura's infrastructure.

> All water is cycled in a closed-loop system
> Dry compost toilets do not require water for flushing, which eliminates all blackwater
> Compost from toilets could be used to fertilize Valldaura soils
> Urine contains nitrogen, phosphorus, and potassium, which in diluted form could be used as fertilizer for plants
> Closed-loop showers run on only 5 L of water, which can be filtered and reused for weeks
> With proper filters, water from baths can also be reused, as well as water from washing clothes and dishes (all cycles can be kept separate and specific to their particular activities in order to reduce complexity of greywater treatments)
> Greywater that is diluted enough can be used to water plants directly, provided they are not root plants that could be eaten in raw form
> Oil can be settled and filtered from cooking water, which is otherwise rich in nutrients for plants
> Ultimately all the water would be used to grow food for Valldaura house, with the soil doubling as the ultimate greywater purification system and outputing water at its desired purity

WATER, WATER EVERYWHERE // existing concepts



Stay tuned for next semester...